Appendix E – Instructions for Calculating Awards

Please use the following equations for the award calculations required in the following forms:
▪ Section 4 of the "Application for Spring 2007Award" Form
▪ Section 4 of the "Re-Application for Award"

"Allowances" in these equations means the number of allowances to be awarded to a project sponsor, which is equivalent to the amount of central power plant NOx emissions avoided during the summer ozone season, rounded to the nearest whole ton using conventional arithmetic rounding. For example, a project that yields a result of .50 tons (1,000 pounds) of NOx displaced would qualify for an award of one allowance. A project that yields 1.8 tons (3,600 pounds) of NOx displaced would qualify for two allowances.

Energy efficiency projects

Eligible energy efficiency projects qualify to receive allowances based on the number of kilowatt hours of electricity saved during an ozone control period, using the following equation:

$$\text{Equation 1:}$$
$$\text{Allowances} = S_{kwh} * 0.0015 * 1/2000$$

Where:
▪ Allowances = The number of allowances awarded to a project sponsor.
▪ S_{kwh} = The number of kilowatt hours of electricity saved by the project during an ozone control period.
▪
▪ 0.0015 = The assumed emission rate (in pounds of NOx per kilowatt hour) of coal-fired generation that energy conservation is presumed to prevent, as specified in 10 RSMo 6.360
▪ 1/2000 = The conversion factor necessary to convert pounds of NOx to tons of NOx per kWh for the purposes of allocating allowances
▪ S_{kwh} should be calculated as baseline or business as usual (BAU) electricity consumption minus electricity consumption after the project has been implemented. Methods for determining baseline or BAU electricity consumption and post-project electricity consumption are discussed in the section on Measurement and Verification (M&V).

Zero-emission renewable generation projects

Eligible zero-emissions renewable generation projects, including generation from biogas, qualify to receive allowances based upon the number of kilowatt hours of electricity the project generates during an ozone control period using the following equation:

$$\text{Equation 2:}$$
$$\text{Allowances} = G_{out} * 0.0015 * 1/2000$$

Where:
▪ Allowances = The number of allowances awarded to a project sponsor.
▪ Gout= Net project electric generation (in kWh) during summer ozone season
▪ 0.0015 = The assumed emission rate (in pounds of NOx per kilowatt hour) of coal-fired generation that renewable generation is presumed to prevent, as specified in 10 RSMo 6.360

- $1/2000$ = The conversion factor necessary to convert pounds of NOx per kilowatt hour into tons of NOx per kilowatt hour for the purposes of allocating allowances.

Biomass generation projects

Biomass generation projects qualify to receive allowances based upon the number of kilowatt hours of electricity each project generates during an ozone control period, with an adjustment for NOx emissions from biomass firing, using the following equation:

Equation 3:
Allowances = (G_{out} * 0.0015 - $ER_{project}$)* 1/ 2000

Where:
- Allowances = The number of allowances awarded to a project sponsor
- G_{out}= Net project electric generation (in kWh) during summer ozone season
- 0.0015 = The assumed emission rate (in pounds of NOx per kilowatt hour) of coal-fired generation that renewable generation is presumed to prevent, as specified in 10 RSMo 6.360
- $ER_{project}$ = The NOx emission rate for the biomass-fired generation in pounds of NOx per kilowatt hour. $ER_{project}$ is determined on a case-by-case basis by the project sponsor in cooperation with DNR. In calculating project NOx emissions, sponsors may voluntarily go beyond methods required for obtaining an air permit but will not be required to do so.
- $1/2000$ = The conversion factor necessary to convert pounds of NOx per kilowatt hour into tons of NOx per kilowatt hour for the purposes of allocating allowances.

If biomass is being co-fired with other fuel in a conventional combustion process, G_{out} should be estimated as a share of total electricity generated based on the share of total heat input that is provided by the biomass. If the co-firing process is not a conventional combustion process, G_{out} should be determined on a case-by-case basis by the project sponsor in cooperation with DNR.

Combined heat and power (CHP) projects

Combined heat and power (CHP) projects qualify to receive allowances based upon reducing NOx emissions during the summer ozone season. Equations 4-6 are used to calculate the number of allowances to be awarded to the project. In addition, to qualify for an award, the CHP installation is required to achieve an energy efficiency threshold of at least 60 percent. Equation 7 is used to calculate whether this threshold has been achieved.

The calculation of the award is based on the difference between actual NOx emissions from the CHP system and the NOx emissions that would be emitted by an equivalent business-as-usual (BAU) system, using the following equation:

Equation 4:
Allowances = NOx $_{BAU}$ - NOx $_{CHP}$

The equivalent BAU system is assumed to consist of a conventional power plant that produces electricity plus a conventional industrial boiler that produces useful heat (heat used for space, water or industrial process heat).

NOx emissions from the BAU system are calculated assuming that the conventional power plant has a generation efficiency of 34% and an emission rate of 0.15 pounds NOx per million Btu of heat input and that the conventional steam boiler has an efficiency of 80 percent and an emission factor of 0.17 pounds NOx per million Btu of heat input, using the following equation:

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Equation 5:
$$NOx_{BAU} = [G_{out} * (1/34\%) * 3412 * .15*(1/10\wedge 6)] + [H_{out} * (1/80\%) * 0.17]$$

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Where:
- G_{out}= Net project electric generation (in kWh) during summer ozone season
- 34% = Assumed generation efficiency for a conventional power plant
- 3,412 = Heat content of electricity (Btu per kWh)
- 0.15 = Assumed NOx emissions rate (lb. per million Btu) for a conventional power plant
- H_{out}= Net project output of useful heat (in million Btu) during summer ozone season
- 80% = Assumed thermal efficiency of a conventional steam boiler
- 0.17 = Assumed NOx emissions rate (pounds per million Btu) for a conventional steam boiler

The NOx emissions from the CHP system are calculated using the following equation:

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Equation 6:
$$NOx_{CHP} = H_{in} * ER_{project}$$

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Where:
- H_{in} = The heat input (in million Btu) used by the project to produce electricity and useful heat during the summer ozone season
- $ER_{project}$ = The NOx emission rate (in pounds of NOx per million Btu of heat input) for the project

Calculating NOx emissions from the CHP system will require the project sponsor to determine a project-specific NOx emission rate. $ER_{project}$ will be determined on a project-specific basis by the project sponsor in consultation with the DNR Energy Center. In determining the project NOx emissions, the sponsor may voluntarily go beyond methods required for obtaining an air permit but will not be required to do so.

To qualify for an award, the CHP system is required to achieve at least 60 percent efficiency. Efficiency of a CHP project is calculated according to the following equation:

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Equation 7:
$$Eff_{CHP} = \frac{(G_{OUT} * 3412/10\wedge 6) + H_{OUT}}{H_{IN}}$$

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Where:
- Eff_{CHP} = The calculated energy efficiency of the CHP project
- G_{OUT}= Net project electric generation (in kWh) during summer ozone season
- 3,412 = Heat content of electricity (Btu per kWh) of electricity
- H_{OUT}= Net project output of useful heat (in million Btu) during summer ozone season. Useful heat could be used for space, water, or industrial process heat
- H_{IN} = Project heat input (in million Btu) during the summer ozone season.